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A PLEISTOCENE FLORA FROM FAIRBANKS, ALASKA

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INTRODUCTION

The material here described was collected in 1929 by Mr. Peter Kaisen, near Fairbanks, Alaska. This expedition was under the joint auspices of Alaska College and The American Museum of Natural History, and the valuable mammalian fossils which were its principal objective are being studied by Mr. Childs Frick. The writers wish to express to Mr. Frick and Dr. C. E. Bunnell of Alaska University their appreciation of the opportunity he has given them to study the plant collections.

The plants occur at several localities, all of which are in the vicinity of Fairbanks. Due to burial in frozen muck, their preservation is excellent, with structures little if any altered.

Pleistocene floras of western North America are well known only from the coast of California. This is the first record of the occurrence of a considerable group of species from Alaska. The association of these plants with the remains of Pleistocene mammals is of especial importance, since it makes possible a more accurate definition of the physical conditions. The presence of numerous specimens of well-preserved fungi adds interest to the Fairbanks flora, since these organisms are rarely preserved in the fossil record.

All of these specimens are part of the collections of The American Museum of Natural History. The numbers of figured specimens are indicated in the descriptions of the figures.

COMPOSITION OF THE FLORA

Of the 27 plants recognized, all except two can be placed in modern genera. All of the remainder are either referred definitely to modern species, or a resemblance to them is indicated. Following is a list of the plants included in the flora:

Phylum Thallophyta
Class Fungi
Order Lycoperdales

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Family Lycoperdaceae
Bovista plumbea Pers.
Order Polyporales
Family Polyporaceae
Fomes applanatus (Pers.) Gill.
Fomes fomentarius (L.) Gill.
Fomes pinicola (Schwehd.) Cooke
Ganoderma lucidum (Leyss.) Karst
Phylum Spermatophyta
Class Gymnospermae
Order Coniferales
Family Pinaceae
Picea glauca Voss.
Class Angiospermae
Subclass Monocotyledonae
Order Graminales
Family Cyperaceae
Carex(?) sp. A
Carex(?) sp. B
Eriophorum sp. A
Eriophorum sp. B
Subclass Dicotyledonae
Order Salicales
Family Salicaceae
Salix arctica Pall.
Salix glauca L.
Salix daphnoides Vill.
Salix reticulata L.
Populus tremuloides Michx.
Order Fagales
Family Betulaceae
Betula alaskana Sarg.
Betula glandulosa Michx.
Order Caryophyllales
Family Caryophyllaceae
Arenaria sajanensis Willd.
Silene acaulis L.
Silene sp.
Order Ranales
Family Ranunculaceae
Ranunculus cf. *eschscholtzii* Schlecht.
Order Rhoedales
Family Cruciferae
Draba fladnizensis Wulf.
Order Rosales
Family Rosaceae
Potentilla villosa Lehn.
Potentilla sp.

Order Primulales
Family Primulaceae
Androsace villosa L.
Order Polemoniales
Family Polemoniaceae
Phlox cf. *sibirica* L.
Order Asterales
Family Compositae
Taraxacum ceratophorum (Led.) D.C.

More than half of the fossil flora as now known is made up of herbaceous species. There are 8 species of trees or shrubs, with the latter the more common growth form in the latitude of Fairbanks. Of the 5 species of fungi, 4 are parasitic upon woody plants. Following is the classification according to habit:

Herbs	Trees or Shrubs	Fungi
Androsace villosa	*Betula alaskana*	*Bovista plumbea*
Arenaria sajanensis	*Betula glandulosa*	*Fomes applanatus*
Carex(?) sp. A	*Picea glauca*	*Fomes fomentarius*
Carex(?) sp. B	*Populus tremuloides*	*Fomes pinicola*
Draba fladnizensis	*Salix arctica*	*Ganoderma lucidum*
Eriophorum sp. A	*Salix daphnoides*	
Eriophorum sp. B	*Salix glauca*	
Phlox cf. *sibirica*	*Salix reticulata*	
Potentilla villosa		
Potentilla sp.		
Ranunculus cf. *eschscholtzii*		
Silene acaulis		
Silene sp.		
Taraxacum ceratophorum		

The trees and shrubs, represented largely by leaves, wood and fruiting structures, appear to have been brought into the sites of deposition by wind or water, and to have accumulated in the bog in much the same way as are corresponding structures in Tertiary deposits. The fungi were doubtless accumulated in a similar manner. It may be supposed that the trees on which they grew were situated close to the sites of deposition. Most of the remains of herbaceous plants are a part of the caches of rodents, and their abundance in our collections is due to this selective agency, and to the fact that continuous freezing has preserved them ever since their time of accumulation. Figure 11 shows a mass of seeds, 5 × $4\,^3/_4$ × 3 inches in dimensions, which represents a portion of one of these caches.

PHYSICAL INDICATIONS

There is little to indicate that the climate differed measurably from that of today during the time the plants of the Fairbanks flora were being accumulated. Of the species which are still known to be living, all are typically boreal or alpine in distribution at the present time, and with few exceptions are known to occur in the vicinity of Fairbanks. Two of the willows, *Salix arctica* and *S. reticulata*, occupy more exposed situations along the coast or in the mountains, but their absence from the modern flora can hardly be explained as due to climatic change. The rarity of these species in the fossil record is suggestive of a habitat somewhat removed from the sites of deposition in the Fairbanks area, and it is probable that their leaves were transported down from higher levels.

The herbs commonly occur in boreal America where the ground remains frozen throughout the year, thawing only near the surface during the summer. The capsules and seeds which make up the record are more perfectly preserved than those of the California Pleistocene, in which freezing has not been a factor in preservation. It is reasonable to assume that low subsoil temperatures have characterized this region almost continuously since the plant remains were accumulated.

The gopher holes in which most of the seeds occur have been dug many feet into muck which is now frozen. Since rodents at the present time do not appear to be able to burrow into permanently frozen ground, it seems possible to conclude that the ground was not as extensively frozen when the seeds were placed in the burrows as is now the case. Either the permanently frozen soil was farther below the surface than at present, or it was only seasonal during the time the plants were accumulated. Fluctuation of the level of the zone of frost, due to variations in temperature or precipitation, is consistent with evidence of climatic changes at lower latitudes during the Pleistocene.

AGE OF THE PLANT REMAINS

On the basis of the species represented in the Fairbanks flora, the age of the deposits in which it occurs might be considered to be Recent. The only common species which has not been identified in the living vegetation of Alaska is an indeterminate *Silene*, whose capsules are among the most abundant fossils in the flora. This species can not in itself be considered to indicate any great geologic age, in view of its association with so many others which are still living.

The association of the plants with extinct fossil mammals,[1] including

[1] Frick, 1930, Jour. Amer. Mus. Nat. Hist., XXX, No. 1, pp. 71–80.

such typical Pleistocene species as *Aenocyon dirus alaskensis, Arctodus yukonensis, Bison crassicornis, Bootherium sargenti, Camelops, Equus alaskae, Felix atrox alaskensis, Mammonteus primogenius, Mastodon americanus* and *Symbos tyrelli*, is the only indication of their antiquity. This involves the assumption that the plants are contemporaneous with the mammals, an assumption which appears to be sound on the basis of the field evidence now at hand.

In this connection it is of interest to note that three genera of the Fairbanks flora, *Betula, Carex* and *Ranunculus*, have been reported by Sukachoff[1] in the stomach contents of a mammoth. Twelve other species of plants, all boreal in modern distribution, were included in the food of this elephant, whose remains were found on the Berezovka River, in the Province of Yucutsk, Siberia.

Comparison of the Fairbanks flora with other Pleistocene floras in western America brings out an absence of critical relationship, which might be expected in view of their difference in latitude. However, it may be recorded that the Tomales flora,[2] from coastal California north of San Francisco Bay, includes the following Fairbanks genera or species: *Carex* sp., *Fomes applanatus, Picea sitchensis* and *Salix* sp. The San Bruno flora,[3] from coastal California south of San Francisco Bay, includes *Carex* sp. and *Silene* sp. The climate on the California coast during the Pleistocene was cool temperate, and the forest was dominated by closed-cone pines and other plants which have survived in suitable localities in areas adjacent to the fossil localities. The difference between the vegetation from California to Alaska during the Pleistocene was of the same order as at the present time, and was consistent with their difference in latitude.

Most of the technical distinctions between deposits of Pleistocene and Recent age lose their sharpness in a region such as Fairbanks, whose present climate might be considered to be typically Pleistocene. The absence from the region at the present time of most of the mammalian types recorded in the frozen muck, and the extinction of most or all of the species, is the only evidence of a considerable interval of time since the plants associated with them were buried and preserved.

SYSTEMATIC DISCUSSION

Since almost all of the plants recognized in the Fairbanks flora are referred to modern species, it is not considered necessary to describe

[1] 1914, 'Scientific Results of the Expedition sent by the Academy of Sciences to the Berezovka River for the Investigation of the Mammoth found in 1901,' Russian Acad. Sci., III.
[2] Mason, 1934, Carnegie Inst. Wash., Pub. 415, No. 4, pp. 81–179.
[3] Potbury, 1932, Carnegie Inst. Wash., Pub. 415, No. 2, pp. 25–44.

them in this report. The structures preserved, the localities where they occur and their modern distribution are considered below.

There are several types of seeds which have not as yet been recognized. It may be supposed that their absence from our list will not affect our conclusions in any important respect.

Acknowledgment is due to Dr. Carleton R. Ball, formerly of the University of California, for his assistance in the determination of the species of *Salix*, and to Dr. Lee Bonar, of the University of California, for his determination of the fungi. Both of the authors have had field experience in Alaska, and the junior author has collected practically all of the species represented in the fossil flora in the course of his journey along the coast of Alaska to Point Barrow.

FUNGI

Bovista plumbea Pers.

Figures 12, 21 and 22

The preservation of this puffball has been due to the thick, leathery membrane characteristic of *Bovista*. The specimen, flattened by pressure, is 2.3 cm. in diameter. Inside the peridium there are preserved tapering capillitia which are also indicative of this genus. Associated with these are abundant spores, bearing elongate pedicels which characterize *B. plumbea*.

OCCURRENCE.—Head of Goldstream, Buried Forest.

Fomes applanatus (Pers.) Gill.

Figures 3 and 7

This species is represented by a sporophore which has suffered no apparent alteration, as is the case with the species of bracket fungi which follow. It is world-wide in distribution, occurring on trunks of angiosperms most commonly, and rarely on coniferous wood.

OCCURRENCE.—Lillian Creek, Livingood.

Fomes fomentarius (L.) Gill.

Figure 4

This fungus is common on the trunks of various angiosperms, but the host in the case of our specimen was *Betula*, as shown by the fragments of birch bark still attached to it.

OCCURRENCE.—Head of Goldstream, Buried Forest.

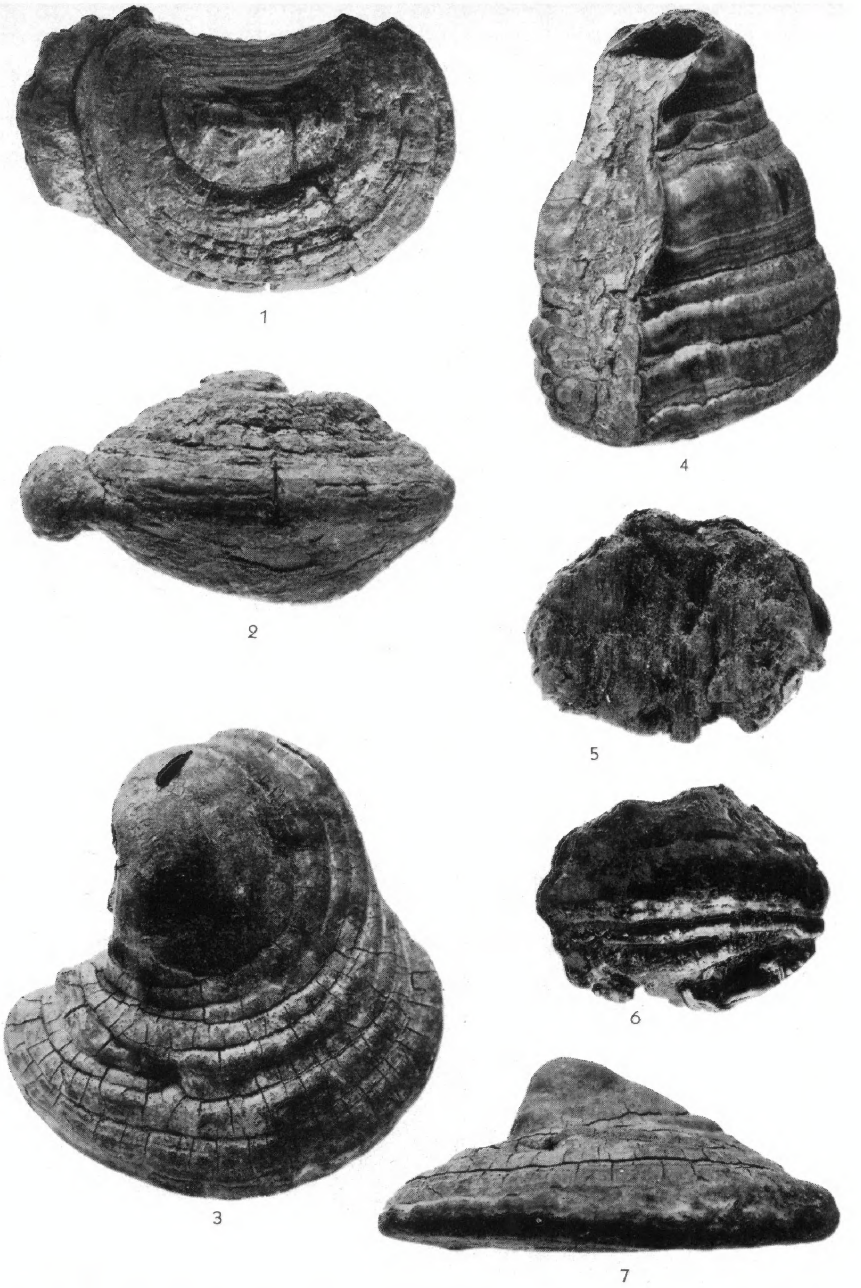


Fig. 1. *Fomes pinicola* (Schwehd.) Cooke. Upper surface. Plesiotype. A.C.–F:A.M.30851.

Fig. 2. *Fomes pinicola* (Schwehd.) Cooke. Side view. Plesiotype. A.C.–F:A.M.30851.

Fig. 3. *Fomes applanatus* (Pers.) Gill. Upper surface. Plesiotype. A.C.–F:A.M.30848.

Fig. 4. *Fomes fomentarius* (L.) Gill. Showing the surface attached to the host when *in situ*. Plesiotype. A.C.–F:A.M.30850.

Fig. 5. *Ganoderma lucidum* (Leyss.) Karst. Showing the surface attached to the host when *in situ*. Plesiotype. A.C.–F:A.M.30853.

Fig. 6. *Ganoderma lucidum* (Leyss.) Karst. Side view. Plesiotype. A.C.–F:A.M.30853.

Fig. 7. *Fomes applanatus* (Pers.) Gill. Side view. Plesiotype. A.C.–F:A.M. 30848.

All figures one-half natural size.

Fomes pinicola (Schwehd.) Cooke

Figures 1 and 2

This species is common over the northern hemisphere, but is generally restricted to coniferous trees.

OCCURRENCE.—Head of Goldstream.

Ganoderma lucidum (Leyss.) Karst

Figures 5 and 6

Occurring in both hemispheres, this species is largely confined to angiosperms.

OCCURRENCE.—Head of Goldstream.

CONIFER

Picea glauca Voss.

Figures 8, 9 and 10

Widely distributed in higher latitudes, this species approaches the shores of the Arctic Ocean near Bering Strait, and is present in the Fairbanks area today. A large tree at the southern end of its range, it is limited to a meter in height in exposed situations at the North.

A small branch bearing leaves, as well as numerous wood fragments and cones have been preserved. The latter still contain well-preserved seeds.

OCCURRENCE.—Fairbanks; Cleary Creek, 1 1/2 miles below Cleary, 15 feet below surface.

MONOCOTYLEDONS

Cyperaceae

All of the seed collections contain abundant achenes of *Carex* and *Eriophorum*. Whereas certain of these can be definitely designated as *Eriophorum*, there are others which may be either *Eriophorum* or *Carex*. There are still others which appear to be *Carex* and are referred with doubt to this genus. The presence of numerous species of both genera in boreal regions at the present time makes the reference of our material to *Carex* and *Eriophorum* wholly consistent.

Carex (?) sp. A

Figures 43 and 44

Carex (?) sp. B

Figures 45 and 46

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below

Fig. 8. *Picea glauca* Voss. Foliage. Plesiotype. A.C.–F:A.M.30855.

Fig. 9. *Picea glauca* Voss. Seed. Plesiotype. A.C.–F:A.M.30856.

Fig. 10. *Picea glauca* Voss. Cone. Plesiotype. A.C.–F:A.M.30856.

Fig. 11. Seed mass from a rodent burrow. The large capsules are *Silene* sp. The small seeds represent the remains of an undetermined fruit. A.C.–F:A.M. 30876.

Fig. 12. *Bovista plumbea* Pers. Plesiotype. A.C.–F:A.M.30845.

All figures natural size.

surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

Eriophorum sp. A
Figure 47

Eriophorum sp. B
Figure 48

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

DICOTYLEDONS

Salix arctica Pall.
Figures 15 and 18

This species, represented by the two leaves figured, was probably not common along the valleys where most of the plants represented in this collection lived. At the present time it ranges along the Arctic coast and in the more exposed mountain habitats. Occurring as a low shrub, the opportunities for wide dissemination of its leaves are less than in the case of taller willows. Its comparative rarity in the fossil record may be considered to be due to its low stature, and the remoteness of its habitat from sites of deposition.

OCCURRENCE.—Fairbanks.

Salix daphnoides Vill.
Figure 13

Except for a limited range into British Columbia and the Yukon Territory, *Salix daphnoides* Vill. is confined to Alaska where it is widely distributed. It extends along the coast from the Alaskan peninsula to the Bering Sea. In the interior it is associated with *Betula alaskana.*

OCCURRENCE.—Head of Goldstream, Buried Forest.

Salix glauca L.
Figure 14

A few leaves represent this species which today is the most common Alaskan willow. It is widely distributed throughout Alaska except along the Arctic coast, extending into the Yukon Territory and British Columbia.

At Savage River Camp in Mt. McKinley National Park, *S. glauca* occurs

13

14

15

16

17

18

19

20

Fig. 13. *Salix daphnoides* Vill. Plesiotype. A.C.–F:A.M.30866.
Fig. 14. *Salix glauca* L. Plesiotype. A.C.–F:A.M.30867.
Fig. 15. *Salix arctica* Pall. Plesiotype. A.C.–F:A.M.30864.
Fig. 16. *Betula glandulosa* Michx. Plesiotype. A.C.–F:A.M.30871.
Fig. 17. *Salix reticulata* L. Plesiotype. A.C.–F:A.M.30868.
Fig. 18. *Salix arctica* Pall. Plesiotype. A.C.–F:A.M.30865.
Fig. 19. *Populus tremuloides* Michx. Showing tooth marks of beaver. ×1/2. Plesiotype. A.C.–F:A.M.30869.
Fig. 20. *Betula alaskana* Sarg. Plesiotype. A.C.–F:A.M.30870.

Figures 13 to 18 and 20 natural size.

with *Picea glauca*, *S. daphnoides* and *S. reticulata*. It is commonly associated with *S. daphnoides* and *Betula alaskana* along streams in less exposed regions such as the valley of the Tanana at Fairbanks.

OCCURRENCE.—Head of Goldstream, Buried Forest.

Salix reticulata L.

Figure 17

A single leaf in the collections exhibits the diagnostic foliar characters of *Salix reticulata* L. The distribution and habitat requirements of this species correspond with those of *Salix arctica;* both range along the coast from Norton Sound southward, occasionally extending into higher mountains. *Salix reticulata* has not been recorded from the modern flora at Fairbanks, but occurs in the adjacent mountains. Herbarium specimens indicate its presence at Healy, Alaska (1368 feet altitude), and at Savage River Camp (2650 feet) in association with *Salix daphnoides* and *S. glauca.*

OCCURRENCE.—Head of Goldstream, Buried Forest.

Populus tremuloides Michx.

Figure 19

Widespread over the whole of the North American continent, the aspen is a common tree along the Yukon river, and is found in the Fairbanks region.

It is represented in our collections by several pieces of wood, representing branches or small trees. Two of the specimens have been chewed by beavers.

OCCURRENCE.—Cleary Creek, 1 1/2 miles below Cleary.

Betula alaskana Sarg.

Figure 20

A number of leaves represent *Betula alaskana.* This species, regularly associated with *Picea glauca* in the mountains up to timber line, is also found bordering the rivers of Alaska. In the Kenai Peninsula Plateau where it grows most abundantly, it extends to the shores of Turnagain Arm, up Shushitna River and its tributaries, and to the west side of Cook Inlet. Although rare on the seaward side of the coast mountains, it is common in the interior valleys, and in particular throughout the Yukon River Valley and its tributaries. At Fairbanks, *Betula alaskana* is growing in open woodland with *Picea glauca.*

OCCURRENCE.—Head of Goldstream, Buried Forest.

Betula glandulosa Michx.

Figure 16

Several leaf specimens have been referred to *Betula glandulosa*, the scrub birch. This species has a wide geographic range. In California it is a dwarf shrub growing only in the higher mountains. It extends northward into Alaska where it is of common occurrence along the coast from Cape Nome to Kodiak Island and southward, spreading inland through the Yukon River drainage and Mt. McKinley National Park. *Betula glandulosa* usually grows in open forests with spruce; however, specimens have been collected from rocky hillsides near the north boundary of Mt. McKinley National Park, at an elevation of 2400 feet, as well as in the tundra along Norton Sound.

OCCURRENCE.—Head of Goldstream, Buried Forest.

Arenaria sajanensis Willd.

Figures 55 and 56

Capsules and seeds of this circumpolar species are numerous.

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

Silene acaulis L.

Figures 38 and 41

This is a common species in Arctic latitudes and in alpine Eurasia. Capsules and seeds are numerous in our collections.

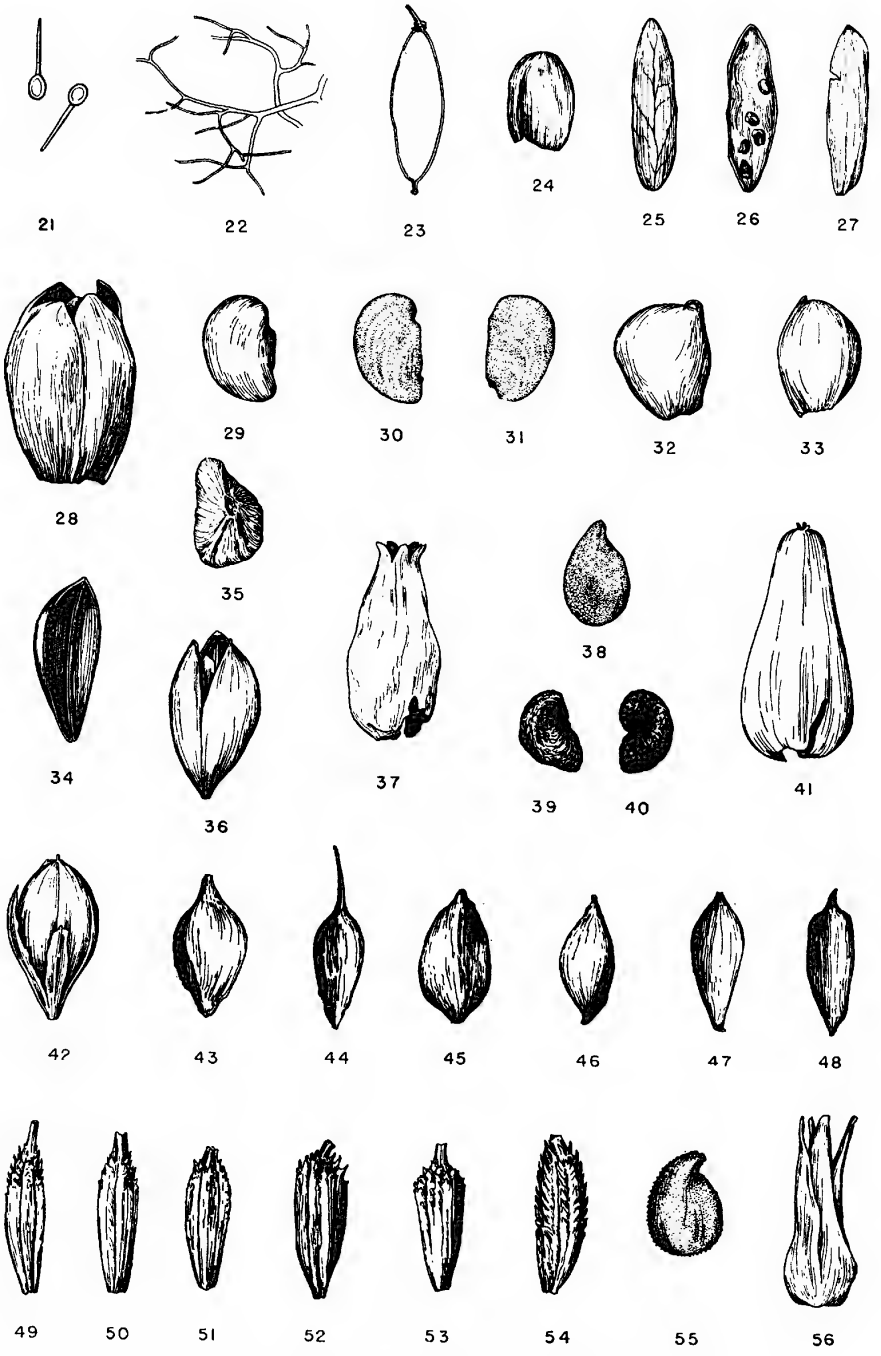
OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

Silene sp.

Figures 11 (in part), 37, 39 and 40

This is the most abundant fruiting structure in our collections. No modern species with corresponding capsules and seeds has been observed, but a further study of the members of this genus in high latitudes should result in the definite determination of our material.

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.



(See opposite page for captions)

Captions for Figs. 21–56

Fig. 21. *Bovista plumbea* Pers. Spores. ×200. From Plesiotype. A.C.–F:A.M.30845.

Fig. 22. *Bovista plumbea* Pers. Capillitia. ×100. From Plesiotype. A.C.–F:A.M.30845.

Fig. 23. *Draba fladnizensis* Wulf. Replum. ×5. Plesiotype. A.C.–F:A.M 30882.

Fig. 24. *Draba fladnizensis* Wulf. Seed. ×18. Plesiotype. A.C.–F:A.M. 30883.

Figs. 25–27. *Draba fladnizensis* Wulf. Capsule valves. ×4. Plesiotype. A.C.–F:A.M.30884–6.

Fig. 28. *Androsace villosa* L. Capsule. ×10. Plesiotype. A.C.–F:A.M. 30890.

Fig. 29. *Potentilla villosa* Lehn. Seeds. ×9. Plesiotype. A.C.–F:A.M. 30887.

Figs. 30, 31. *Potentilla* sp. Seeds. ×9. A.C.–F:A.M.30888, 30889.

Figs. 32, 33. *Ranunculus* cf. *eschscholtzii* Schlecht. Achenes. ×10. Plesiotype. A.C.–F:A.M.30880, 30881.

Fig. 34. *Phlox* cf. *sibirica* L. Capsule valves. ×6. Plesiotype. A.C.–F:A.M.30892.

Fig. 35. *Androsace villosa* L. Seed. ×10. Plesiotype. A.C.–F:A.M.30891.

Fig. 36. *Phlox* cf. *sibirica* L. Capsule. ×6. Plesiotype. A.C.–F:A.M. 30893.

Fig. 37. *Silene* sp. Capsule. ×3. A.C.–F:A.M.30877.

Fig. 38. *Silene acaulis* L. Seed. ×12. Plesiotype. A.C.–F:A.M.30874.

Figs. 39, 40. *Silene* sp. Seeds. ×15. A.C.–F:A.M.30878, 30879.

Fig. 41. *Silene acaulis* L. Capsule. ×3. Plesiotype. A.C.–F:A.M.30875.

Fig. 42. *Phlox* cf. *sibirica* L. Capsule with calyx adhering. ×6. Plesiotype. A.C.–F:A.M.30894.

Figs. 43, 44. *Carex* (?) sp. A. Achenes. ×7. A.C.–F:A.M.30858, 30859.

Figs. 45, 46. *Carex* (?) sp. B. Achenes. ×7. A.C.–F:A.M.30860, 30861.

Fig. 47. *Eriophorum* sp. A. Achene. ×6. A.C.–F:A.M.30862.

Fig. 48. *Eriophorum* sp. B. Achene. ×6. A.C.–F:A.M.30863.

Figs. 49, 50. *Taraxacum ceratophorum* (Led.) D.C. Var. A. Achenes. ×5. Plesiotype. A.C.–F:A.M.30895, 30896.

Fig. 51. *Taraxacum ceratophorum* (Led.) D.C. Var. A (?). Achene. ×6. Plesiotype. A.C.–F:A.M.30897.

Figs. 52, 53. *Taraxacum ceratophorum* (Led.) D.C. Var. B. Achenes. ×5. Plesiotype. A.C.–F:A.M.30898, 30899.

Fig. 54. *Taraxacum ceratophorum* (Led.) D.C. Var. C. Achene. ×5. Plesiotype. A.C.–F:A.M.30900.

Fig. 55. *Arenaria sajanensis* Willd. Seed. ×12. Plesiotype. A.C.–F:A.M. 30872.

Fig. 56. *Arenaria sajanensis* Willd. Capsule. ×6. Plesiotype. A.C.–F: A.M.30873.

Ranunculus cf. **eschscholtzii** Schlecht.

Figures 32 and 33

Achenes of *Ranunculus* are less numerous than most other fruiting structures. They are not sufficiently well preserved to make certain their reference to the modern species *R. eschscholtzii*. In its modern distribution, this species ranges from Alaska to California where it is subalpine.

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

Draba fladnizensis Wulf.

Figures 23 to 27

The replums and seeds of this species are numerous. At the present time it is widely distributed in Arctic and alpine areas in the northern hemisphere.

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

Potentilla villosa Lehn.

Figure 29

Like most of the other herbs, this species is now circumpolar in distribution. Its seeds are numerous in our collection.

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

Potentilla sp.

Figures 30 and 31

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

Androsace villosa L.

Figures 28 and 35

The capsules and seeds of this species are relatively few in number. While it is found only at one locality, a more thorough search elsewhere

would probably disclose its presence. This species is now circumpolar in distribution.

OCCURRENCE.—Head of Goldstream.

Phlox cf. **sibirica** L.

Figures 34, 36 and 42

This circumpolar species is represented by numerous capsules, to some of which the calyx is attached.

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

Taraxacum ceratophorum (Led.) D.C.

Figures 49 to 54

Taraxacum is represented by achenes, some of which retain portions of the beak. Considerable variation is evident in their surface features. Some of them are muricate only near the tip, while others are muricate considerably below the middle. These differences are used in modern plants to segregate species, but in the absence of any other portions of the plant it is considered best to treat them as an aggregate, under the name *T. ceratophorum.* There appear to be three different kinds of achenes, which are designated in the figure legends as Vars. A, B, and C.

T. ceratophorum is circumpolar in its modern distribution.

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.